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A new global GPS dataset for testing and improving modelled GIA uplift rates

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1. Motivation

- Providing an observational estimate of vertical land motion (VLM) due to global glacial isostatic adjustment (GIA).
- Developing a novel fully-automatic post-processing strategy to deal with the challenges of GPS time series analysis in general, and for GIA purposes in particular (see Fig. 1).
- Comparing our data-based solution, GlobalMass (GM) GPS dataset, with 13 global GIA solutions (see Figs. 2 and 3).

2. Data: GPS VLM and GIA models

Global GPS data set

- GPS time series provided by the Nevada Geodetic Laboratory (NGL; <http://geodesy.unr.edu/>).
- Up components for >15,700 sites (IGS08 reference framework).
- List of jump locations provided.

Antarctica

- Uplift rates from regional A-NET dataset at 65 GPS sites.
- Provided in the ITRF2008 reference frame.
- Various corrections applied (e.g., atmosphere, elastic VLM).

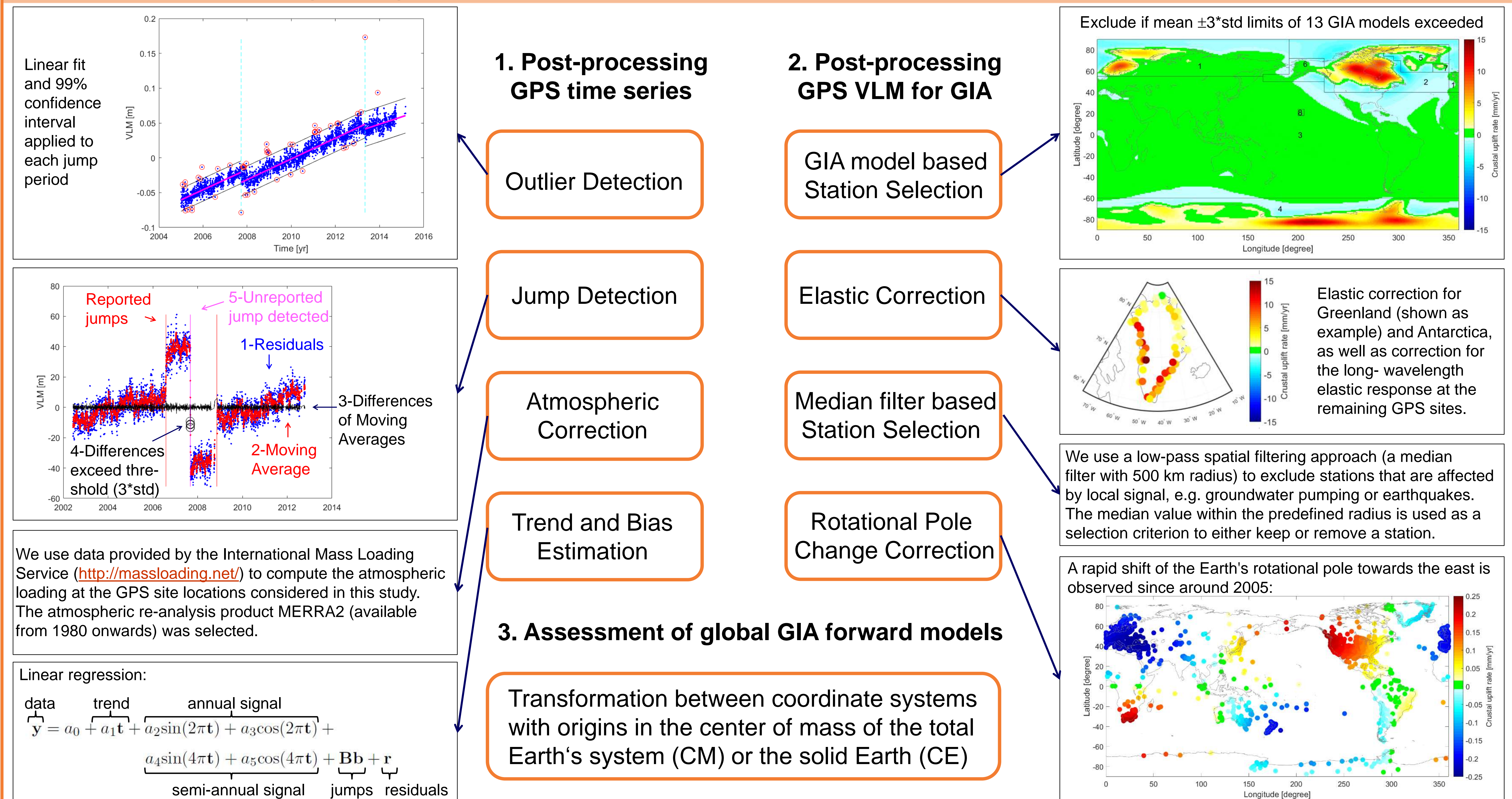
Greenland

- Uplift rates from regional G-NET dataset at 54 GPS sites.
- processed in the IGS08 reference frame.
- corrected for atmosphere, elastic VLM, etc.

13 GIA forward models

- Different assumptions and model parameters lead to different spatial fields of GIA.
- We compare our results with 13 different GIA models (from [Guo et al., 2012, J Geodyn.](#)).

3. Method: Post-processing strategy



4. Results:

(a) Novel GPS data set

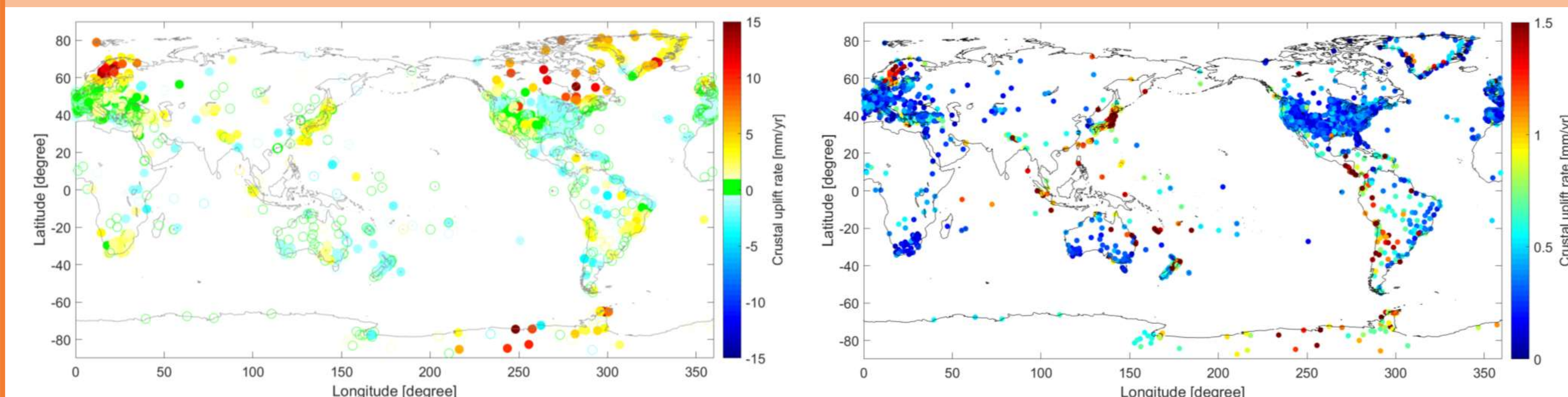


Fig. 2: The GlobalMass (GM) global GPS dataset (4072 sites): (left) GIA uplift rates in mm/yr and (right) their uncertainties. The statistically-significant (99% confidence level) rates in (a) are shown by solid (filled) circles, while rates that are not significant are shown with hollow circles.

(b) Comparison to global GIA forward models

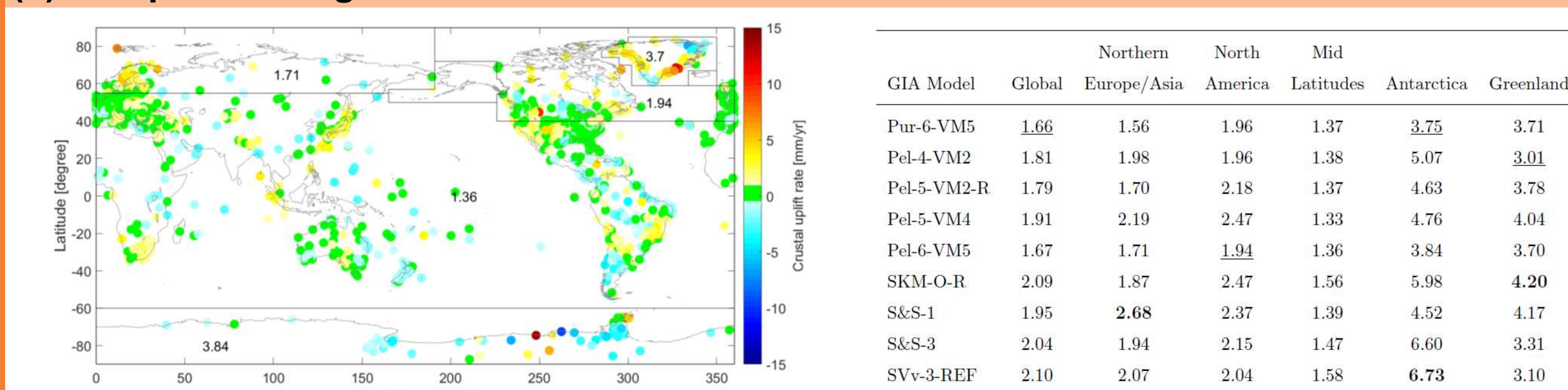


Fig. 3: (above) Assessment of the ICE-6G (Pel-6-VM5) model using the GM global GPS dataset (GPS minus ICE-6G). Spatial RMS differences averaged over five regions are shown in mm/yr. (right) Spatial RMS differences in mm/yr averaged over the entire globe and five regions for 13 global GIA models.

5. Conclusions and Outlook

Conclusions

- The final GM GPS dataset provides a clean GIA signal for more than 4000 sites and, thus, can be used to assess global GIA forward models, as well as to improve them.
- Significant disagreements are found in comparison to 13 GIA forward models, especially for Antarctica and Greenland resulting from uncertain mantle rheology and (recent) ice loading history, as well as errors in the GPS data set.
- The performance of different GIA models varies considerably between regions.

Outlook

- A Bayesian statistical framework will be used to combine the GM GPS data set, along with data on ice mass, hydrological mass and sea level changes and, as well as prior information from geophysical models, to allow new insights about the different contributors to sea level rise on a basin and global scale.

More details

- Schumacher, M., King, M., Rougier, J., Sha, Z., Khan, S.A. and Bamber, J.L. (under revision) A new global GPS dataset for testing and improving modelled GIA uplift rates. Geophysical Journal International.

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